ASBESTOS REGULATION AND SUBSTITUTION IN BRAKE LININGS

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ASBESTOS REGULATION AND SUBSTITUTION IN BRAKE LININGS

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Summary

The fibrous nature, chemical composition and physical properties of asbestos make it valuable for many industrial applications. Unfortunately, pneumoconiosis, lung cancer and mesothelioma have been associated with the inhalation of asbestos dust.

Regulations, enacted or proposed, by many governments to control or ban the use of asbestos have motivated the development of substitutes. Steel, glass and organic fibres have emerged as substitutes. While no single fibre has the balance of properties and cost to be directly substitued for asbestos for most of its uses, products containing combinations of these fibres are now in use in brake linings and clutch facings.

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Sommaire

La nature fibreuse, la composition chimique, et les propriétés physiques de l'amiante la rendent utile pour plusieurs applications industrielles. Malheureusement, la pneumoconiose, le cancer du poumon et le mésothéliome ont étés associés à l'inhalation de poussière d'amiante.

Des règlements, proposés ou mis en vigueur par plusieurs gouvernements afin de limiter ou d'interdir l'utilisation de l'amiante, ont motivés le développement de substituts. Des fibres d'acier, de verre ou organiques sont apparus comme substituts. Même si aucun fibre ne peut substituer directement pour l'amiante dans plusieurs applications, des produits composés de plusieurs types de fibres sont maintenant en usage pour les garnitures de freins et d'embrayages.

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1.0 Introduction

This report is concerned with the automotive application of asbestos, notably friction products such as brake and clutch linings.

A more comprehensive and yet reasonably concise description of the occurrence, varieties, properties, uses and health effects of asbestos can be found in an EMR Canada publication(1). Also, since asbestos has been extensively studied (particularly the health effects) there is a host of additional literature available.

2.0 Uses of Asbestos

The major applications of asbestos are as follows: asbestos cement, representing about 70 per cent of world consumption; friction materials, representing some 15 per cent of consumption; and papers and felts as well as a large number of paints, sealants, asphalts and other products in which asbestos is an important additive. Most of today's product applications are confined to those uses where the fibre is effectively locked into a matrix such as cement, plastic or resin(1).

2.1 Friction Products

Moulded friction materials, including disc and drum brakes and clutch facings for motor vehicles, are the most common products. These are made from a mixture of asbestos (40%), resin and other materials(1).

3.0 Health Effects

The three main diseases that have been associated with the inhalation of asbestos dust are: pneumoconiosis, lung cancer and mesothelioma. Other types of cancer have been attributed to asbestos exposure, although the evidence at present is inconclusive(2).

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4. The Regulation of Asbestos

4.1 Canada

Although the use of asbestos is banned under The Hazardous Products Act for general use clothing, toys, dry-wall cement and some other products, Canadian policy is one of controlled use. As noted by the Ontario Royal Commission: "We consider it better to regulate a known hazard vigorously than to compel the use of substances whose hazardous nature, being unknown, is not subject to regulation to a similar degree of rigour"(2).

In 1981, the Canadian government adopted a position on asbestos that was agreed to in principle by all the provinces of Canada. This position recommends the systematic control and implementation of safety measures for all aspects of asbetos use.

Existing regulations concerned with occupational exposure to asbestos dust require that atmospheric contamination within the work place be limited to a time weighted average of 2 fibres or less per cubic centimetre of air.

The use of the more hazardous types of asbestos has been banned in some jurisdictions.

Federal regulations require that air that is exhausted from asbestos mines and mills to the environment should not contain more than 2 fibres per cubic centimetre.

The use of sprayed-on materials that contain asbestos fibre has been discontinued.

The use of asbestos in friction products has not been banned although regulated precautions in the workplace (e.g. brake repair, manufacture) are required.

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4.2 U.S.A.

In the U.S., regulations on the use of asbestos are similar to those in Canada. In addition, the EPA has proposed a rule to ban the manufacture, importation and processing of asbestos construction products and all asbestos clothing with a ban on friction products to follow 5 years later. The proposed rule is currently undergoing the regulatory process.

4.3 Europe

The situation in Europe is similar to that in North America with variations among nations. At least one nation (Denmark) has banned the use of asbestos brake linings in passenger cars and certain trucks.

4.4 Current Regulatory Activities (U.S. and Canada)

In May 1988 The Asbestos Institute of Canada and The Asbestos Information Association of North America requested the EPA to place the proposed rule banning asbestos in obeyance until it considers further alternatives based on new data. The EPA reaffirmed its position not to hold the rulemaking in obeyance and not to repropose the rule. EPA officials stated that they hope the rule will be final by the end of November 1988.

The Canadian government submitted written comments on June 29, 1988 on the EPA studies reaffirming its position on the controlled use of asbestos; rather than banning.

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5.0 Substitutes for Asbestos in Friction Materials

A list of properties of asbestos which are particularly useful in friction materials is given in Table 1 (3):

Table 1

Properties of Asbestos Useful in Friction Materials

1.	Heat Resistant - stable to 400°C, retains useful properties above 400°C
2.	Decomposes above 650°C to other solid silicates
3.	Decomposition products have higher friction than asbestos
4.	Low thermal conductivity
5.	Strong
6.	Flexible
7.	Non-springy - low rate of fibre recovery
8.	Resistant to breakage under shear
9.	High surface area
10.	Absorbent to resins and rubbers molten or in solution
11.	Surface readily wetted by and adheres to resins and rubbers
12.	Readily available in a range of fibre lengths in quantity at relatively low cost

None of the substitute fibres found has all the required characteristics and blends of two or more are almost always used(3). The main substitute fibres used in brakes and clutches are combinations of steel, organic and glass fibres.

5.1 Disc Pads(3)

Compromising cost and performance, steel fibres have been widely adopted as the main reinforcement replacing asbestos. For many years, both in North America and Europe, so-called "semi-metallic" disc brake pads, containing high volumes of steel fibre, roughly equivalent to the asbestos replaced, have been available. Though commercially successful, their very high thermal conductivity can lead to overheating of the hydraulic brake fluid. More recent formulations replace some of the steel fibre content by organic fibres, including aramid* or by inorganic fillers.

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These later formulations have lower thermal conductivity and a better overall balance of friction and wear properties over a range of duties. Their life is typically 1.5 to twice as long as asbestos pads, at only slighly higher cost.

*Aramid: a generic term designating manufactured organic fibres of the aromatic polyamide type.

5.2 Drum Brakes(3)

Because of its radiused shape, the manufacturing processes for drum brake linings are more complex than for disc brakes and so finding replacement fibres to match the processing characteristics of asbestos is even more important, if investment in expensive new plant is to be avoided. In general, tough fibres have been chosen, to ease processing.

Steel fibre with some added organic fibre (for example aramid) has been the main reinforcement replacing asbestos. E-Glass fibre is brittle and has found only limited use. Though it offers good strength, reasonable heat-resistance and low cost, its wear products are abrasive and can damage the brake drum. At high temperatures, under heavy duty it can melt and cause frictional fade.

5.3 Extent of Market Penetration by Substitutes

In the replacement or aftermarket there is virtually no penetration by substitutes. In original equipment sales, substitution has usually been linked to introduction of new models. Virtually 100% conversion of car disc brakes, drum linings and clutch facings has been achieved in Germany and Scandinavia. In UK the conversion has been slower, but still substantial (30%-70%). In contrast, there has been very little substitution in France and Italy.

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Commercial vehicle linings have proved technically more difficult to substitute and the rate of conversion is much lower than for automobile linings.

In North America, as in Europe, there has been virtually no substitution in the aftermarket, but substantial conversion in original equipment particularly of disc brake pads. A report by the American Society of Mechanical Engineers concluded that automobiles and most trucks could have completely non-asbestos friction systems by 1992 (ASME 1987).

References

(1) Energy, Mines and Resources Canada, Asbestos (Catalogue # M35-28/1986E)

(2) Report of the Royal Commission on Matters of Health & Safety Arising from the Use of Asbestos in Ontario, Ontario Ministry of the Attorney General (1984)

(3) Heron, G.F., Asbestos Substitution - An Overview, 32nd International SAMPE Symposium April 6-9, 1987.